

Rec'd PCT/PTO 12 JAN 2005



PCT/GB2003/002938 10/521136



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

**PRIORITY  
DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)

REC'D 06 AUG 2003

WIPO

PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 28 July 2003

BEST AVAILABLE COPY

## Patents Form 1/77

The  
Patent  
Office

1/77

Patents Act 1977  
(Rule 16)

## Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office

Cardiff Road  
Newport  
Gwent NP9 1RH

1. Your reference

2. Patent application number  
(The Patent Office will fill in this part)

0216290.7

15JUL02 1733183-1 002903

P01/7700 0.00-0216290.7

15 JUL 2002

3. Full name, address and postcode of the or of  
each applicant (underline all surnames)Reckitt Benckiser (Australia) Pty Limited  
44 Wharf Road  
West Ryde  
New South Wales 2114  
AUSTRALIA

Patents ADP number (if you know it)

7954431001

If the applicant is a corporate body, give the  
country/state of its incorporation

Australia

4. Title of the invention

Device

5. Name of your agent (if you have one)  
"Address for service" in the United Kingdom  
to which all correspondence should be sent.  
(including the postcode)John C. McKnight  
Reckitt Benckiser plc  
Group Patents Department  
Dansom Lane  
Hull  
HU8 7DS  
UNITED KINGDOM

Patents ADP number (if you know it)

7800303001

6. If you are declaring priority from one or more  
earlier patent applications, give the country  
and the date of filing of the or of each of these  
earlier applications and (if you know it) the or  
each application number

Country

Priority application number  
(if you know it)Date of filing  
(dd/mm/yyyy)7. If this application is divided or otherwise  
derived from an earlier UK application,  
give the number and the filing date of  
the earlier applicationNumber of earlier application  
(day / month / year)Date of filing  
(day / month / year)8. Is a statement of inventorship and of right  
to grant of a patent required in support of  
this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d)).

Patents Form 1/77

BEST AVAILABLE COPY

0041693: 15-JUL-02: 04:54

## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form.  
Do not count copies of the same document

Continuation sheets of this form

Description

Claim(s)

Abstract

Drawing(s)

10

4

1

4

10. If you are also filing any of the following, state how many against each item.

Priority documents  
Translations of priority documents

Statement of inventorship and right  
to grant of a patent (Patents Form 7/77)

Request for preliminary examination  
and search (Patents Form 9/77)

One

Request for substantive examination  
(Patents Form 10/77)

One

Any other documents  
(please specify)

F82

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

John C. McKnight

15 July 2002

12. Name and daytime telephone number of  
Person to contact in the United Kingdom

John C. McKnight (01482) 583719

## Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

## Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500507.
- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500507.
  - Write your answers in capital letters using black ink or you may type them.
  - If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
  - If you have answered "Yes" Patents Form 7/77 will need to be filed.
  - Once you have filled in the form you must remember to sign and date it.
  - For details of the fee and ways to pay please contact the Patents Office.

Patents Form 1/77

BEST AVAILABLE COPY

0047693:15:J01:02:04:54

11056P5

DUPLICATE

1

DEVICETechnical Field

- This invention relates to moulded combustible products that emanate a  
5 pesticide into the atmosphere on combustion and more particularly to such  
products that undergo combustion for a prolonged period thereby providing an  
extended time period of pesticidal activity.

Background Art

- The kind of products to which this invention relates are commonly  
10 referred to as "mosquito coils". Such coils are characterised by being formed  
from a combustible material which is shaped into a circular helix. Included in  
the combustible material are one or more pesticides, which in the case of  
products active against mosquitoes will be insecticides. As the product burns,  
the insecticides are emanated into the atmosphere by virtue of their volatility.  
15 Ideally, such coils will provide an effective level of insecticide in the atmosphere  
for an appropriate time period.

- Typically, mosquito coils are used in environments where persons sleep  
and are therefore unable to destroy mosquitoes before being bitten. Another  
usage is environments where infants or others incapable or having a limited  
20 ability of destroying attacking mosquitoes are placed.

- It will be readily appreciated that mosquitoes are vectors for a number of  
particularly persistent and often life-threatening or at least debilitating diseases.  
Most significant among these diseases is malaria. It is therefore highly  
desirable to prevent mosquito bites as a means of preventing the contracting of  
25 such diseases.

- Mosquitoes are particularly prevalent in tropical and sub-tropical regions.  
Many of these regions include countries with relatively low per capita incomes.  
It is therefore desirable to be able to provide pesticidal products that are highly  
cost effective. In general terms, traditional mosquito coils fulfil this role. They  
30 are relatively easy to form and include low cost ingredients. As emanation of  
the insecticide is only dependant on combustion of the coil, the only source of  
energy required is sufficient heat to initially ignite a coil to cause it to combust.  
However, one feature that is lacking in such coils is the ability to reliably  
provide a period of sufficient insecticidal activity while a person sleeps  
35 overnight. Typically coils should provide up to about 8 hours of insecticidal  
coverage. However, due to breakage, it is not uncommon for a coil to burn for

11056P5

2

- a significantly shorter period of time. This requires that a person sleeping awake and recognise that the coil is not burning, then carefully relight the unbroken portion whilst ensuring that it is intact and correctly mounted. Such a requirement is not conducive to maintaining an effective overnight coverage against mosquito bites.

- At this point it is worth noting that traditional mosquito coils are formed as planar circular helices in a moulding or other shaping process. At the terminal end of the coil, approximately in the centre, is a small aperture which is used to locate the mosquito coil on an upstanding pin. The upstanding pin usually projects out of a dish or tray which is used to collect the ashes of the combusted coil. Locating of the coil on the pin results in the coil separating out so as to form a continuous spiral with the beginning of the coil, which is where combustion commences, at a point lower than the terminal end which sits on the locating pin. In this way the continuous spiral forms a track which combusts from the outer beginning end to the mounted terminal end.

- It should be appreciated that mosquito coils may also be formed as double circular helices. In these structures, the helices are formed co-terminously. However, prior to use, each helix must be separated out. One important reason for producing coils in this way is that of economical use of available material as well as ease of formation in manufacture.

- As mentioned above, typically mosquito coils are subject to breakage. This arises out of the fact that they are quite brittle and during manufacture, rather than being produced in a planar form, coils may warp to assume a wavy or convex conformation. In some cases, a free end or tip of the coil may curl upwardly. It is therefore well recognised that breakage may occur during manufacture, packaging, transport and in use by a consumer. In this latter case, it is important that a consumer exercise considerable care in both opening and mounting a coil. More especially in the case of double helical coils, care must be taken in separating out each coil so as to avoid breakage. Again it must be emphasised that any breakage of a coil effectively results in a coil being shortened both in length and most significantly, burn time.

- Another known method of making mosquito coils is by treating thick pieces of cardboard with an insecticide. The cardboard may be made of layers of thinner sheets which are stacked on top of one another until the desired thickness is achieved. The multi-layered cardboard is then cut to the required shape of the coil. While this method reduces the breakage of the coil, the

11056P5

3

cutting of the thick cardboard results in the damage and breakage of the cutting knives. The costs associated with the regular replacement of the knives is significant.

- Whilst recognising the short comings of traditional mosquito coils, the present inventors have sought to provide an improved coil which is capable of providing a prolonged effective period of insecticidal coverage and is produced in a manner resulting in a cost effective product relative to the traditional coil.

- This has been achieved by recognising that rather than forming the coils as planar helices which need to be handled with some care, the coils are moulded to a form which significantly reduces the chance of breakage and does not involve cutting thick cardboard.

#### Disclosure of Invention

- Accordingly, in a first aspect the present invention consists in a combustible pesticidal product comprising a structural element formed of a moulded pulp of organic fibrous material, cellulose fibres, wood free fibres, or mixtures thereof, the product including one or more pesticides, which product on combustion emanates the pesticide into the atmosphere.

- In a second aspect, the present invention consists in a method of making a combustible pesticidal product comprising the steps of:
- forming a pulp of organic fibrous material, cellulose fibres, wood free fibres, or mixtures thereof,
  - the addition of one or more pesticides, and
  - moulding the product by vacuum moulding to form a combustible pesticidal product.

- Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

- For the purposes of describing this invention, reference will be made to mosquito coils, although it must be appreciated that this invention is not so limited.

- In a preferred embodiment, the product is formed by moulding a pulp into the desired shape. Typically the shape will be helical although not necessarily circular.

The pulp is moulded into the shape of a mosquito coil by vacuum moulding, preferably thermoforming.

Vacuum moulding involves feeding a pulp product into a hydropulper to form a solution, a mould covered by a mesh screen being lowered into the solution, and a vacuum being applied to the mould. The use of the vacuum causes fibres to be drawn to the surface of the mould, being a single immersion, or if necessary a number of immersions, and once a sufficient fibre depth is drawn onto the mould the mould is removed from the solution, the vacuum then being used to dewater the pulp. Operating vacuums of 25 to 29 inches of Mercury are preferable. The product may then be transferred from the mould to another mould, with or without compression and dried either in or out of the mould. Methods of drying include but are not limited to direct heat, microwaves or exposure to sunlight. The product is then pressed to the required density either within the mould or after the product has been transferred from the mould.

The thermoforming process is similar to vacuum moulding in that a mould covered by a mesh screen is immersed into a pulp solution and a vacuum is applied to the mould. After a sufficient fibre depth has been drawn onto the mould it is removed from the solution. This mould is then pressed either mechanically or pneumatically or a combination thereof, between a corresponding transfer mould to remove water. This transfer mould may be heated and may also have a vacuum applied to it to aid dewatering. The product may then be held in this transfer mould and moved to another mould for further processing. Further processing may include compression between heated or unheated moulds. Transference of the product from mould to mould can be achieved using compressed air and vacuums. The product is dried in the mould using pressures of between 50 to 1500kPa, preferably 200 to 600kPa, most preferably 400kPa and at a temperature of between 80 to 400°C, preferably 250°C. The product may undergo further processing, for example, stamping or pressing to improve the product qualities.

There are also many permutations for forming the product using both vacuum moulding and thermoforming techniques in different processing orders. Some of these permutations could include;

pressing and heating the product at the same time or separately,  
pressing the product after or before drying,

11056P5

5

partially drying the product then pressing, preferably followed by further drying,

using heated or unheated moulds,

drying the product either in or out of the mould,

5 using mechanical or pneumatic means to press and transfer products,

using vacuums and/or compressed air being heated or unheated to aid in dewatering.

To aid transfer of the pulp product from the mould, the sides of the mould may be slightly tapered. An angle of 0-30 degrees, preferably 5-10 degrees is  
10 commonly used and is termed the 'draft angle'.

The advantages of thermoforming over most other methods of processing include high output rates, good quality physical properties in finished parts, namely a smooth surface finish on both sides of the product, density control, and thickness control, and less space and energy requirements  
15 as there is no need for a drying oven.

The pulp can be manufactured from readily available and inexpensive combustible organic fibrous materials, cellulose fibres and wood free fibres. Examples, without limitation include waste paper and cardboard, old newspaper, kraft pulp, coconut powder, straw, bagasse, bamboo, cane, straw,  
20 grasses, weeds, tea leaves, charcoal powder, sawdust, cotton, cloths, rags, and husks of materials such as rice, wheat and coconuts. Preferably, old newspaper is used.

Whilst this invention is applicable to a variety of pesticidal substances, the preferred form relates to the use of insecticides, particularly insecticides  
25 that are effective against mosquitoes.

The insecticides used in this invention comprise all residual insecticides, including non-microencapsulated insecticides, microencapsulated insecticides as well as mixtures of non-microencapsulated and microencapsulated insecticides.

30 It is preferred that the one or more insecticides comprise substances which are toxic to mosquitoes. Without limitation, these include esbiothrin, d-alallethrin, prallethrin, transfluthrin, bioallethrin, esbioallethrin, pyrethrins, citronella, pyrethroids, neem oil and mixtures thereof. When esbiothrin, d-alallethrin, prallethrin, transfluthrin, bioallethrin, esbioallethrin, pyrethrins, and  
35 mixtures thereof are used, typically they will be in an amount of from 0.01 to 0.6 % w/w, preferably to 0.02 to 0.3 % w/w, most preferably 0.04 to 0.1 % w/w.



11056P5

6

When pyrethroids, neem oil, citronella and mixtures thereof are used, typically they will be in an amount of from 0.01 to 10 % w/w, preferably to 0.01 to 6 % w/w, most preferably 0.04 to 6 % w/w.

Emanation of the pesticide into the atmosphere occurs as a result of the pesticide being volatilised as the coil burns. At the front or tip of combustion of a coil, the temperature may be 200-500°C. However, behind the tip, the temperature will be somewhat lower owing to the insulation properties of the pulp. This means that compounds such as esbiothrin which boil at 160-170°C will be volatilised and released into the atmosphere behind the burning tip.

The pulp may include an accelerant, being an alkali earth metal nitrate or nitrite in an amount of from 0.04 to 1.83 % w/w. Preferably, the alkali earth metal nitrate or nitrate will be included in an amount of from 0.20 to 1.20 % w/w, most preferably about 1.11 % w/w. The nitrates or nitrites that may be used include sodium, potassium, calcium, magnesium and mixtures thereof. It is preferred to utilise potassium as the nitrate or the nitrite, preferably as the nitrate.

As an alternative to the alkali earth metal nitrate or nitrite, the pulp may include an alkali earth carbonate or bicarbonate in an amount of from 0.02 to 1.83 % w/w. Preferably the alkali earth metal carbonate or bicarbonate will be included in an amount of from 0.10 to 1.00 % w/w, most preferably about 0.82 % w/w. The carbonates or bicarbonates that may be used include sodium, potassium, calcium, magnesium and mixtures thereof. It is preferred to use potassium carbonate.

Sodium silicate may be included in the pulp in an amount of from 0.01 to 1.37 % w/w. Preferably, the sodium silicate may be included in an amount of from 0.10 to 0.70 % w/w, most preferably about 0.56 % w/w.

A phosphate in an amount of from 0.01 to 0.40 % w/w and selected from the group consisting of diammonium phosphate, monoammonium phosphate, triammonium phosphate and mixtures thereof may be included in the pulp. Preferably the phosphate may be included in an amount of from 0.02 to 0.40 % w/w, most preferably about 0.14 % w/w. Furthermore, of these phosphates, diammonium phosphate is preferred.

A boron compound in an amount of from 0.01 to 0.92 % w/w and selected from the group consisting of boric acid, sodium tetraborate hydrous, sodium borate, potassium borate, calcium borate, zinc perborate, boronatrocalcite and mixtures thereof may be included in the pulp. Preferably

11056P5

7

the boron compound may be included in an amount of from 0.10 to 0.70 % w/w, most preferably about 0.66 % w/w. Furthermore, of these boron compounds, sodium borate is preferred.

- It is within the scope of this invention to include a perfume and/or a dye.
- 5 Both the perfume and the dye, if included, will be selected on the basis of satisfying specific organoleptic requirements. It will of course be appreciated that the perfume must be suitably stable under the conditions of combustion of the coil.

- The thickness and width of the pulp are of great importance in determining the burn rate of the coil. It is desired to have a coil which has a low burn rate as less mass is required in the coil. In a preferred embodiment, the structural element is made from moulded pulp, with dimensions of 3-10mm wide by 1-6mm thick, preferably 6mm wide and 4mm thick. The desired length is from 500 to 1500mm, preferably 1100mm. The cross-sectional combustion
- 10 area is shaped in a rectangle, triangle, square, half-circle, u section or combinations thereof. Where the coil is a single helical coil, the weight of the single coil is 8 to 20 grams, preferably 12 grams.

- It has been found that the density of the pulp is also of importance. To achieve appropriate burn times, the pulp has a density of 300-1000kg/m<sup>3</sup>, preferably 400-600kg/m<sup>3</sup>, most preferably 600kg/m<sup>3</sup>. Low densities burn too rapidly, while high densities have difficulty sustaining combustion. A density of about 600kg/m<sup>3</sup> is preferred as the relatively high density provides rigidity to the coil and ensures that the coil does not need to be too large in size. Coils with a density over 600kg/m<sup>3</sup> will sustain combustion by adding accelerants to the
- 20 pulp. However, the use of accelerants increases the burn rate of the coil.

- Other components that may be added to the pulp or applied as a coating after the product has dried include binders, dewatering agents, chemicals to increase the wet and dry strength of the product, starches, for example, Tapioca, Tamarind and corn; gums, for example, guar, arabic and xanthan;
- 30 talc, and glues, for example, PVA. Typically, starch is present in an amount of from 5 to 15% w/w. All other components mentioned may be present in amounts of less than 1% w/w.

- Broadly speaking, the various materials to be included in the pulp may be either incorporated during the preparation of the pulp, applied as a coating
- 35 after the moulded pulp product has been formed or both incorporated and

11056P5

8

applied as a coating. It is preferable that the materials are applied as a coating after the forming of the moulded product.

When a coating is applied, it is important to note that certain of the materials cannot be dissolved in the same solution for coating purposes due to an incompatibility of ingredients. For example, the alkali earth metal nitrate or nitrite and the sodium silicate may be dissolved in the same aqueous solution. Likewise, the alkali metal carbonate or bicarbonate and the sodium silicate; the alkali metal nitrate or nitrite and the phosphate and the alkali metal nitrate or nitrite may each be dissolved in the same aqueous solution.

Whilst the aforementioned materials may be applied as aqueous solutions, the one or more pesticides and the perfume are not generally water soluble. Accordingly, either or both of these materials may be added to the aqueous solution of the other materials along with an emulsifier to ensure that they are uniformly dispersed. Alternatively, they may be dissolved in a solvent and separately applied either before or after the aqueous coating(s).

The inclusion of a dye is optional and depending on the selected dyes solubility may be incorporated in an aqueous solution or in a suitable solvent for separate addition as a coating. If it is incorporated in a non-aqueous solvent, then preferably the solvent will be chosen to dissolve the perfume and the one or more pesticides.

If the dye is incorporated as an aqueous solution, it may be thickened with a suitable thickening agent such as guar gum to form a paste so as to allow application by painting or rolling.

It therefore follows that to apply all of the materials as a coating, a plurality of coatings are required. In such circumstances, drying may be carried out to remove excess water between each coating.

Alternatively, all coatings may be sequentially applied and the resultant coated moulded pulp product dried.

Typically the coat weight before drying will be in the range of from 5 to 240 gm<sup>2</sup>, preferably 5-50 gm<sup>2</sup>. In those instances where all of the materials are applied as a coating, the coat weight is most preferably 30-50 gm<sup>2</sup>.

Application of the coatings may occur using techniques such as rolling, painting, printing or spraying. Naturally, the materials must be dissolved or dispersed in a liquid that is capable of application, desirably to obtain a uniform coating. If printing is used, well known techniques such as offset printing, gravure printing and lithographic printing may be used.

11056P5

9

- When produced as mosquito coils, the products of the invention may burn typically for up to 24 hours. By adjusting parameters such as the density, thickness, width and mass of coil, various burn times may be obtained. For example, burn times of at least 4 hours, preferably 7-8 hours may be obtained.
- 5 It will also be appreciated that the amount of the various additives such as the alkali earth metal nitrate or nitrite, the sodium silicate, the phosphate and the boron compound will affect burn time.

#### Brief Description of the Drawings

- Figure 1 is a graph showing the effect of width and thickness on the burn rate of the product with a density of  $380 \pm 25 \text{ kg/m}^3$ .
- 10 of the product with a density of  $450 \pm 50 \text{ kg/m}^3$ .
- Figure 2 is a graph showing the effect of width on burn rate of three different products with a density of  $450 \pm 50 \text{ kg/m}^3$ .
- Figure 3a is a plan view of the moulding apparatus of Example 1
- Figure 3b is a sectional view A-A of Figure 3a.
- 15 Figure 4 is a view of the vacuum apparatus used in conjunction with the moulding apparatus.

In order to better understand the nature of the invention, a number of examples will now be described.

#### Example 1

- 20 As shown in Figure 3b the moulding apparatus 10 comprises four metal components 11, 12, 13 and 14. The components are a support plate 11, overlaid by a stainless steel mesh screen 12, a suction mould 13, and a press tool 14. Mesh screen 12 is fixed to the mould 13 using fasteners at location 15 in a manner such that the screen is sandwiched between support plate 11 and
- 25 mould 13.
- In use, the mould 13 is placed into a vacuum vessel 16 containing water 17 which is connected to a vacuum pump 18 by a vacuum hose 19 as shown in Figure 4. A 0.5% pulp solution was made by dispersing old newspaper in water with no additives. The pulp solution was poured into the mould 13 and a
- 30 vacuum of 15 to 29 inches of mercury drawn. Once the pulp solution had all been added and sufficiently dewatered the press tool 14 was pressed down into the mould 13 as is best seen in Figure 4. This further dewatered the pulp and was found to produce samples of relatively consistent quality that had a density of about  $300 \text{ kg/m}^3$ . The moulding apparatus 10 was then dismantled
- 35 and the pulp strips removed and dried in an oven at  $65^\circ\text{C}$ . To achieve densities greater than  $300 \text{ kg/m}^3$ , the pulp strips were placed back in the mould 13 after

11056P5

10

drying and compressed between the press tool 14 and the support plate 11 using a hydraulic press. Old newspaper was found to sustain combustion at densities below  $600\text{kg/m}^3$  without the need for accelerants.

### Example 2

- 5 Trials were conducted to compare the effect on burn rate when the thickness, width and density of the strips were altered. Strips were produced of lengths between 4-9mm, with a thickness of 2,3,4 and 5mm at densities of 300,450 and  $600\text{kg/m}^3$ . These strips were then burnt to determine their mass burn rate in g/h.

- 10 Figure 1 shows the effect of varying thickness and widths on burn rate. The observed trends were that increasing width increases burn rate, and increasing thickness increases burn rate.

Figure 2 shows the effect on the burn rate of the product with a density of  $450 \pm 50\text{kg/m}^3$  when an accelerant ( $\text{KNO}_3$ ) is added to newspaper pulp and also

- 15 when using white office paper instead of old newspaper as the main ingredient.

### Example 3

- Trials were conducted to compare the effect on burn rate when white office paper was used as the main ingredient and also when the accelerant potassium nitrate ( $\text{KNO}_3$ ) was used with old newspaper.  $\text{KNO}_3$  was added at a concentration of 0.125% in the pulp solution. Figure 2 shows that using white office paper as a raw material increases the burn rate dramatically. Likewise the addition of  $\text{KNO}_3$  to old newspaper slightly increases the burn rate compared to old newspaper with no additives.

- 25 It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

11056P5

11

CLAIMS:

1. A combustible pesticidal product comprising a structural element formed of a moulded pulp of organic fibrous material, cellulose fibres, wood free fibres, or mixtures thereof, the product including one or more pesticides,
- 5 which product on combustion emanates the pesticide into the atmosphere.
2. A combustible pesticidal product as in claim 1 wherein the product is formed of a vacuum moulded pulp.
3. A combustible pesticidal product as in claim 2 wherein the product is formed of a thermoformed pulp.
- 10 4. A combustible pesticidal product as in claim 3 wherein the product is thermoformed at a temperature of between 80 to 400°C, preferably 250°C, and at a pressure of between 50 to 1500kPa, preferably 200 to 600kPa, most preferably 400kPa.
5. A combustible pesticidal product as in any one of the preceding claims
- 15 wherein the product comprises either incorporating into the wet pulp during its preparation and/or applying to a pulp as a coating thereof at least one of the following:  
an alkali earth metal nitrate or nitrite in an amount of from 0.04 to 1.83% w/w,  
an alkali earth carbonate or bicarbonate in an amount of from 0.02 to 1.83%
- 20 w/w;  
sodium silicate in an amount of from 0.01 to 1.37% w/w;  
a phosphate in an amount of from 0.01 to 0.40% w/w and selected from the group consisting of diammonium phosphate, monoammonium phosphate, triammonium phosphate and mixtures thereof;
- 25 a boron compound in an amount of from 0.01 to 0.92% w/w and selected from the group consisting of boric acid, sodium tetraborate hydrous, sodium borate, potassium borate, calcium borate, zinc perborate, boronatrocalcite and mixtures thereof; and optionally  
a perfume and/or dye.
- 30 6. A method for making a moulded combustible pesticidal product as claimed in claim 1 in which the one or more pesticides are insecticides, preferably esbiothrin, d-allethrin, prallethrin, transfluthrin, bioallethrin, esbioallethrin, pyrethrins, citronella, pyrethroids, neem oil and mixtures thereof.
7. A combustible pesticidal product as claimed in claim 6 wherein the one
- 35 or more pesticides are selected from the group consisting of esbiothrin, d-allethrin, prallethrin, transfluthrin, bioallethrin, esbioallethrin, pyrethrins,

11056P5

12

citronella, pyrethroids, neem oil and mixtures thereof and are in an amount of from 0.01 to 0.6% w/w, preferably 0.02 to 0.3% w/w, most preferably 0.04 to 0.1% w/w.

8. A combustible pesticidal product as claimed in claim 7 wherein the one  
5 or more insecticides are selected from the group consisting of pyrethroids, neem oil, citronella and mixtures thereof and are in an amount of from 0.01 to 10% w/w, preferably 0.01 to 6% w/w, most preferably 0.04 to 6% w/w.
9. A combustible pesticidal product as in any one of claims 5 to 8 wherein the alkali earth metal nitrate or nitrite is included in an amount of from 0.20 to  
10 1.20% w/w, preferably about 1.11% w/w.
10. A combustible pesticidal product as in any one of claims 5 to 9 wherein the nitrates and nitrites are selected from the group consisting of sodium nitrite, sodium nitrate, potassium nitrite, potassium nitrate, calcium nitrite, calcium nitrate, magnesium nitrite, magnesium nitrate and mixtures thereof.
- 15 11. A combustible pesticidal product as in any one of claims 5 to 10 wherein the alkali earth metal carbonate or bicarbonate is in an amount of from 0.01 to 1.00% w/w, preferably about 0.82% w/w.
12. A combustible pesticidal product as in claim 11 wherein the carbonates or bicarbonates are selected from the group consisting of sodium carbonate,  
20 sodium bicarbonate, potassium carbonate, potassium bicarbonate, calcium carbonate, calcium bicarbonate, magnesium bicarbonate, magnesium carbonate and mixtures thereof.
13. A combustible pesticidal product as in any one of claims 5 to 12 wherein the sodium silicate is included in an amount of from 0.01 to 0.70% w/w,  
25 preferably about 0.56% w/w.
14. A combustible pesticidal product as in any one of claims 5 to 13 wherein the phosphate is included in an amount of from 0.02 to 0.40% w/w, preferably about 0.14% w/w.
15. A combustible pesticidal product as in claim 14 wherein the phosphate is  
30 diammonium phosphate.
16. A combustible pesticidal product as in any one of claims 5 to 15 wherein the boron compound is included in an amount of from 0.10 to 0.70% w/w, preferably about 0.66% w/w.
17. A combustible pesticidal product as in any one of the preceding claims  
35 wherein the thickness of the pulp product is from 1mm to 6mm, preferably 4mm.

11056P5

13

18. A combustible pesticidal product as in any one of the preceding claims wherein the width of the pulp product is from 3mm to 10mm, preferably 6mm.
19. A combustible pesticidal product as in any one of the preceding claims wherein the length of the pulp product is from 500 to 1500mm, preferably 1100mm.
20. A combustible pesticidal product as in any one of the preceding claims wherein the density of the pulp product is from 300 to 1000kg/m<sup>3</sup>, preferably 400 to 600kg/m<sup>3</sup>, most preferably 600kg/m<sup>3</sup>.
21. A combustible pesticidal product as in any one of the preceding claims wherein the product has a cross-sectional combustion area shaped in a rectangle, triangle, square, half-circle, u section or combinations thereof.
22. A combustible pesticidal product as in any one of the preceding claims wherein the organic fibrous materials, cellulose fibres and wood free fibres include but are not limited to waste paper and cardboard, old newspaper, kraft pulp, coconut powder, straw, bagasse, bamboo, cane, straw, grasses, weeds, tea leaves, charcoal powder, sawdust, cotton, cloth and rags, and husks of materials including rice, wheat and coconuts.
23. A combustible pesticidal product as in any one of the preceding claims wherein the coating is applied to the pulp by rolling, painting, printing or spraying.
24. A combustible pesticidal product as in any one of the preceding claims wherein other components can be added to the pulp or applied as a coating.
25. A combustible pesticidal product as in claim 24 wherein the components can include binders, dewatering agents, chemicals to increase the wet and dry strength of the product, starches, gums, talc and glues.
26. A combustible pesticidal product as in any one of the preceding claims wherein the product is a mosquito coil having a burn time of at least 4 hours, preferably 7-8 hours.
27. A combustible pesticidal product as in claim 26 wherein the coil is shaped as a single helical coil, double coil, triangular, hexagon, polygon, rectangular or other configurations.
28. A combustible pesticidal product as in claim 27 wherein the coil is a single helical coil and the weight of the single coil is 8 to 20 grams, preferably 12 grams.
29. A method of making a combustible pesticidal product comprising the steps of:



11056P5

14

forming a pulp of organic fibrous material, cellulose fibres, wood free fibres, or mixtures thereof,

the addition of one or more pesticides, and  
moulding the product by vacuum moulding

5 to form a combustible pesticidal product.

30. A method of making a moulded combustible pesticidal product substantially as hereinbefore described with reference to the Examples 1 and 2.

31. A method of making a moulded combustible pesticidal product  
10 substantially as hereinbefore described with reference to the accompanying Figures 3a, 3b and 4.

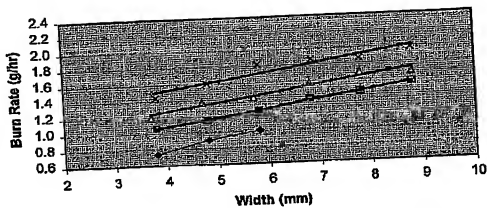
32. A combustible pesticidal product when made according to the method of claim 29.

ABSTRACTDEVICE

A combustible pesticidal product is disclosed which comprises a structural element formed from a pulp of organic fibrous material, cellulose fibres, wood free fibres or mixtures thereof, the product including one or more pesticides which product on combustion emanates the pesticide into the atmosphere.

- 5 Typically the combustible product will be a mosquito coil which has been impregnated with one or more insecticides effective against mosquitoes. On combustion of the coil, insecticide is emanated into the atmosphere for a period of 7-8 hours.

FIG. 1

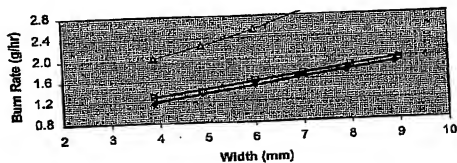
**WIDTH & THICKNESS EFFECT**  
Density ~ 380 + 25 kg/m<sup>3</sup>

Thickness & Density

- ◆ ~2.5 mm @ 400kg/m<sup>3</sup>
- ~3.8 mm @ 400kg/m<sup>3</sup>
- △ ~4.9 mm @ 380kg/m<sup>3</sup>
- × ~6 mm @ 380kg/m<sup>3</sup>

FIG. 2

WIDTH EFFECT  
Density ~ 450 + 50 kg/m<sup>3</sup>



Thickness & Density

- ◆ Test A - 4 mm @ 450kg/m<sup>3</sup> from 0.5% solution
- Test B - 4 mm @ 450kg/m<sup>3</sup> from 0.5% solution + KNO<sub>3</sub>
- ▲ Test C - 4 mm @ 450kg/m<sup>3</sup> from 0.5% solution (White Office Paper)

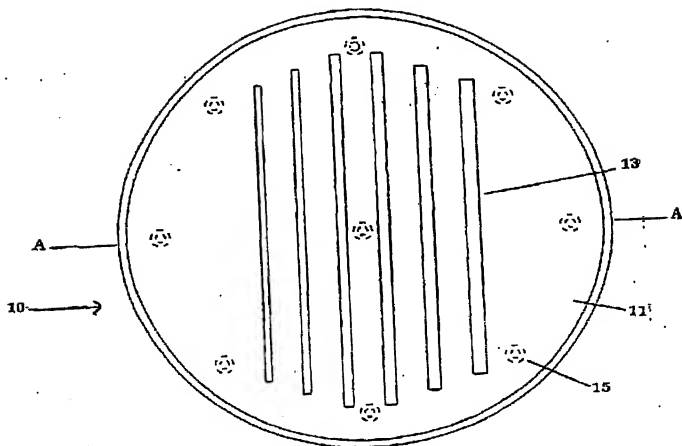


FIG. 3A

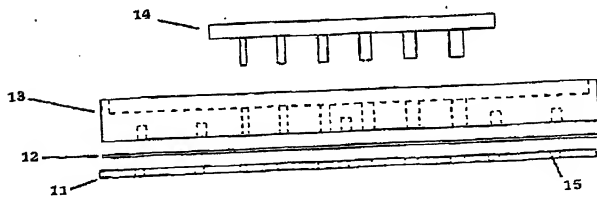


FIG. 3B

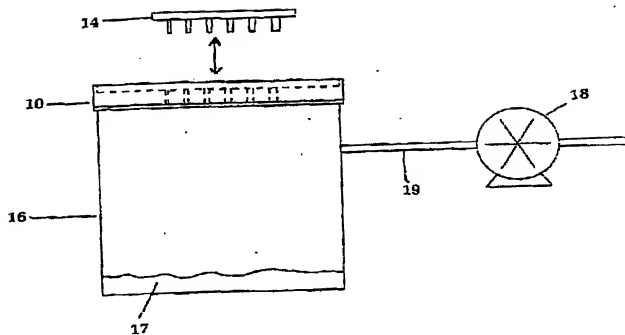


FIG. 4

BEST AVAILABLE COPY

0041692:15-Jul-02:06:54

THE PATENT OFFICE

29 JUL 2003

Received in Patents  
International Unit